12-27-04 AFS IZW

Docket No.: 109

December 23, 2004

Mail Stop Appeal Brief - Patents
Commissioner For Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Re:	Applicant(s):	Vargas, Jaime, et. al.	
	Assignee:	Cardica, Inc.	
	Title:	Tool for Performing End-to-End Anastomosis	
	Serial No.:	10/083,235	
	Examiner:	Bradford C. Pantuck	Filed: February 26, 2002
	Docket No.:	109	Group Art Unit: 3731

Dear Sir:

Transmitted herewith are the following documents in the above-identified application:

(1) Return Receipt Postcard;
(2) This Transmittal Letter;
(3) Appeal Brief Under 37 CFR 41.37; and
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Respectfully submitted,

Brian A. Schar
Attorney for Applicant(s)
Reg. No. 45,076

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Vargas, Jaime S.; et. al.		
Assignee:	Cardica, Inc.		
Title:	Tool for Performing End-to-End Anastomosis		
Serial No.:	10/083,235	Filing Date:	February 26, 2002
Examiner:	Bradford C. Pantuck	Group Art Unit:	3731
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December 10, 2004

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF UNDER 37 CFR §41.37

This Appeal Brief is prepared and submitted pursuant to the Notice of Appeal filed in this case on November 12, 2004, in accordance with the new requirements of 69 Fed. Reg. 19960.

I. REAL PARTY IN INTEREST

The real party in interest is the assignee, Cardica, Inc., as named in the caption above.

II. RELATED APPEALS AND INTERFERENCES

No prior or pending appeals, interferences or other judicial proceedings are known to Appellant, Appellant's legal representative, or assignee which may be related to, directly affect or be directly affected by, or have a bearing on the decision by the Board of Patent Appeals in this appeal.

III. STATUS OF CLAIMS

Claims 1-4, 6-8, 11, 12 and 14-16 stand finally rejected. Claims 5, 13, 17 and 18 have been objected to. These claims are set forth in the appendix attached hereto. Dependent claim 13 claims a channel, and the specification was objected to on the ground that the term "channel" was not set forth in the specification.

Claims 19-23 have been withdrawn. These claims are not at issue and are not set forth in the appendix attached hereto.

IV. STATUS OF AMENDMENTS

No amendments were filed after final rejection or are currently pending in this case.

V. SUMMARY OF THE INVENTION

Claim 1 is directed to a tool for performing end-to-end anastomosis between a first tissue structure (2) and a second tissue structure (4) each having at least two flaps (8) at one end, where that tool comprises a first clip (32) configured to hold at least one flap (8) of the first tissue structure (2); a second clip (32) configured to hold at least one flap (8) of the second tissue structure (4); wherein the clips (32) are movable from a first position spaced apart from one another to a second position closer to one another in which each flap (8) held by the first clip abuts a corresponding flap (8) held by the second clip; and at least one connector deployer (72) oriented to deploy at least one connector (74) completely through at least one of two abutting flaps (8).[1] In this way, the ends of the tissue structures are connected together.

[1] *E.g.*, Specification, page 7, line 22 through page 9, line 4; page 11, line 10 through page 16, line 13; Figures 1, 5, 7-8 (exemplary reference characters indicated in text above).

Claims 2-8 and 11-18 depend from independent claim 1, and thus add additional limitations to those present in independent claim 1.

VI. ISSUES

Independent claim 1 stands finally rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 3,911,926 to Peters ("Peters") and U.S. Patent No. 3,265,069 to Healey, Jr. et. al. ("Healey"). In addition, independent claim 1 stands finally rejected under 35 U.S.C. §103(a) as obvious over Healey.

VII. ARGUMENTS

A. The Cited Art Does Not Anticipate Claim 1

The MPEP sets forth the legal standard of anticipation under 35 U.S.C. §102: "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference."[2] (emphasis added).

Claim 1 claims a "tool for performing end-to-end anastomosis between a first tissue structure and a second tissue structure each having at least two flaps at one end, comprising: a first clip configured to hold at least one flap of the first tissue structure; a second clip configured to hold at least one flap of the second tissue structure, wherein said clips are movable from a first position spaced apart from one another to a second position closer to one another in which each flap held by said first clip abuts a corresponding flap held by said second clip; and at least one connector deployer oriented to deploy at least one connector completely through at least one of two abutting flaps."

[2] MPEP 2131 (*quoting Verdegaal Brothers v. Union Oil of California*, 814 F.2d 628, 631 (Fed. Cir. 1987)).

1. Peters

Peters does not expressly or inherently describe each and every element of claim 1. First, Peters fails to expressly or inherently describe the claimed connector deployer. Claim 1 claims, among other elements, a tool for performing end-to-end anastomosis comprising "at least one connector deployer oriented to deploy at least one connector." As set forth in the specification, "[t]he connector deployers are structures or mechanisms for deploying connectors 74 into the flaps 8 to connect them together."[3] The connectors may be staples or "any other connectors, fasteners, structures or mechanisms useful for connecting the flaps 8 of the first tissue structure 2 to the flaps 8 of the second tissue structure 4."[4] The connectors thereby hold the tissue structures 2, 4 together, remaining in the flaps 8 to do so.[5]

In contrast, Peters discloses no connector deployers and no connectors. Instead, Peters discloses a microvascular clamp 10 that includes two clips 11 movable along a bar 12.[6] The clips 11 are configured "for engaging and closing off a blood vessel."[7] The clamp 10 includes a "modified aneurysm clip applier 16 to allow simultaneous placement of both clips 11 on the vessel 15."[8] In use, the clip applier 16 is "employed to open the clips 11 and to position the clamp 10 in the intended position for closing off the vessel 15."[9] When "it is desired to remove the clamp 10...the clip applier 16 is again employed to open the clips 11 and withdraw the clamp 10 from the vicinity of the vessel 15."[10] That is, the invention of Peters "is concerned with an adjustable microvascular U-clamp for use in temporary occlusion of

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[3] Specification; page 14, lines 16-17.

[4] *Id.* at page 14, lines 18-20.

[5] *Id.*, *e.g.*, page 17, lines 2-9; Figure 8.

[6] Peters; *e.g.*, col. 1, lines 58-61; col. 2, lines 8, 33-35; Figure 1.

[7] Peters; col. 2, lines 18-22.

[8] Peters; col. 2, lines 26-30.

[9] Peters; col. 2, lines 35-38.

[10] Peters; col. 2, lines 40-44.

blood vessels during microvascular surgery."[11] (emphasis added). Nowhere does Peters disclose a connector, much less a connector deployer for deploying a connector completely through at least one of two abutting flaps. Unlike the claimed connector, nothing at all of the clamp 10 of Peters is left behind in the patient after the surgical procedure is complete, and as a result Peters cannot connect two separate tissue structures. Indeed, Peters does not connect separate tissue structures; rather, it is a microvascular U-clamp that occludes a single vessel 15 between the clips 11.

The Office Action characterizes the entire microvascular clamp 10 as a connector: "Connector deployer (16) [Fig. 2] is oriented to deploy a connector (the whole assembly 10) and is *capable* of deploying this connector through two flaps." [12] However, this characterization makes no sense, because the clip applier 16 is a component of the overall clamp 10; the entirety of the clamp 10 cannot be deployed from a subassembly from itself. Even if the clamp 10 were assumed to be a connector (which is not admitted), Peters does not disclose that the clamp 10 is deployable "completely through at least one of two abutting flaps." Indeed, if any portion of the clamp 10 were movable into or through the vessel 15, the wall vessel 15 would be punctured, not occluded, and the clamp 10 would be inoperative for its disclosed and claimed purpose of "closing off a blood vessel."[13] Consequently, Peters does not and cannot disclose "at least one connector deployer oriented to deploy at least one connector completely through at least one of two abutting flaps."

Second, construction of the term "connector" to include a removable microvascular clamp 10 such as disclosed in Peters would result in claim 1 failing to read on any embodiment described in the specification at all. The disclosure of the present application

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[11] Peters; col. 1, lines 6-9.

[12] Final Action; page 2.

[13] Peters; *e.g.*, col. 2, lines 18-22, 35-38; claim 1; Figure 3.

nowhere describes the occlusion of a vessel, much less occlusion with the claimed connectors. Indeed, the claimed tool is an anastomosis tool, not a vascular clamp. "Although the specification need not present every embodiment or permutation of the invention and the claims are not limited to the preferred embodiment...neither do the claims enlarge what is patented beyond what the inventor has described as the invention."[14]

Third, Peters fails to expressly or inherently describe workpiece tissue structures having flaps. The only tissue structure disclosed in Peters is a vessel 15.[15] The vessel 15 is a single, intact tissue structure; nowhere in the figures or the specification are one or more flaps in that vessel 15 disclosed or even suggested. Thus, even if Peters disclosed a connector deployer, which it does not, Peters necessarily cannot describe a connector deployer "oriented to deploy at least one connector completely through at least one of two abutting flaps." Further, because Peters has no written description or enablement of workpiece tissue structures having flaps, Peters necessarily has no written description or enablement of "a first clip configured to hold at least one flap of [a] first tissue structure" or of "a second clip configured to hold at least one flap of [a] second tissue structure." Indeed, due to the absence in Peters of any disclosure regarding flaps in a tissue structure, any statements about the use of the microvascular clamp 10 of Peters in conjunction with one or more flaps are speculative at best.

Fourth, the Final Office Action includes an improper inherency rejection. The Final Office Action states that "[c]onnector deployer 16...is *capable* of deploying this connector through two flaps."[16] (emphasis in original). The statement that a structure is "capable" of performing a function is an implicit inherency rejection, because it points to no disclosure of

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[14] *Netword LLC v. Centraal Corp.*, 242 F.3d 1347, 1352 (Fed. Cir. 2001); *Biogen, Inc. v. Berlex Laboratories, Inc.*, 2003 U.S. App. Lexis 1721, *22, 318 F.3d 1132 (Fed. Cir. 2003) (*quoting Netword*, 242 F.3d at 1352).

[15] Peters; *e.g.*, col. 2, lines 26-44; Figures 2-3.

such capability. This inherency rejection is unsupported, contrary to the requirements of the MPEP: "In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art."[17] Because the Final Action provides no support for this inherency rejection, contrary to the requirements of the MPEP, that rejection was improper.

With regard to dependent claim 11, Peters nowhere expressly or inherently describes a staple. Further, as set forth above, Peters does not include a connector deployer, so necessarily Peters cannot disclose a "connector deployer (16)...capable of deploying a staple."[18] In addition, as set forth above, the use of the word "capable" signals that this is an implicit inherency rejection of claim 11, and it is improper for the same reasons set forth about with regard to claim 1.

2. Healey

Healey does not expressly or inherently describe each and every element of claim 1. First, Healey neither expressly or inherently describes the claimed "tool for performing end-to-end anastomosis between a first tissue structure and a second tissue structure each having at least two flaps at one end, comprising...at least one connector deployer oriented to deploy at least one connector completely through at least one of two abutting flaps." The Final Action states that "Healey discloses stapling as a means of connecting the two tissues," presumably the blood vessels 74.[19] Quoting Healey, "reference is made to suturing as the

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[16] Final Office Action, October 1, 2004; page 2.

[17] MPEP 2112 (*citing Ex parte Levy*, 17 U.S.P.Q.2d 1461, 1464 (Bd. Pat. App. & Inter. 1990)) (emphasis in original).

[18] Final Action, page 2.

[19] Final Action, page 3; Healey, Fig. 14.

method of rejoining the severed blood vessels, but it will be understood that any other acceptable method such as stapling or adhesion may be employed."[20] Although Healey suggests the use of stapling as a method for joining the vessels, Healey fails to disclose any structure usable to perform stapling, much less an anastomosis tool that includes a stapler or any other kind of connector deployer. Thus, Healey does not disclose an anastomosis tool that comprises the claimed connector deployer. Healey does not expressly or inherently disclose all of the structural limitations of claim 1.

Second, the Final Action states that the "clips (72) can move longitudinally along the axis of the blood vessel (74), as is evident from the joints (92)." However, neither claim 1 nor any claim depending from it claim such longitudinal motion, and consequently the characterization of the motion of the cylindrical flanged head portions 72 of Healey is irrelevant to claim 1. That characterization is also incorrect. The item 92 characterized as a "joint" is instead a compression spring 92 that places the cylindrical flanged head portions 72 in the closed position by exerting a force on a lever arm 76 connected to the cylindrical flanged head portions 72 and causing the lever arm 92 to pivot about pin 90.[21] Such motion of the lever arm 92 causes the cylindrical flanged head portions 72 to move substantially perpendicular to the axis of the blood vessel 74, not "longitudinally along the axis of the blood vessel (74) as characterized by the Final Action.[22]

Third, Healey fails to expressly or inherently describe workpiece tissue structures having flaps. As shown in Figures 6 and 14, an end of each of two blood vessels 28, 74 is simply everted about a corresponding head of the device, such that "a flanged area of each

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[20] Healey, col. 2, lines 49-52.

[21] Healey; *e.g.*, col. 6, lines 28-34, 49-59, 65-72, Figures 15-16.

[22] *Id.*; Final Action, page 3.

end of the blood vessel [is] upstanding and extending outwardly from the heads."[23] In contrast, the flaps of the workpiece tissue structure of claim 1 are created in the tissue structures by making an incision or incisions therein.[24] Further, the specification of the present application specifically points out the disadvantages of eversion, as disclosed in Healey, for end-to-end anastomosis. The use of tissue flaps on the ends of the tissue structures to be connected overcomes those disadvantages, differentiating the flaps from everted ends of vessels.[25] Because Healey has no written description or enablement of workpiece tissue structures having flaps, Healey necessarily has no written description or enablement of a first clip configured to hold at least one flap of a first tissue structure and a second clip configured to hold at least one flap of a second tissue structure.

With regard to dependent claims 2 and 15, the cylindrical flanged head portions 72 of Healey are not clips. The claimed clips 32 each include at least one edge that is movable relative to the corresponding clamp 20.[26] In contrast, each cylindrical flanged head portions 72 is merely the distal end of, and is fixed to, the corresponding lever arm 76 or shank portion 78.[27] Thus, each cylindrical flanged head portion 72 is not movable relative to the distal end of the corresponding lever arm 76 or shank portion 78, and cannot be a clip as claimed.

With regard to dependent claims 3 and 4, the claimed jig "guides...clamps together such that the flaps of one tissue structure are registered against the corresponding flaps of the other tissue structure."[28] The jig 36 may include rails 38 connected to a frame 40, where the

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[23] Healey; col. 3, lines 62-68; Figures 6, 14.

[24] Specification; *e.g.*, page 2, lines 13-14; page 7, line 22 through page 8, line 4.

[25] *Id.* at page 2, lines 1-3.

[26] Specification; *e.g.*, page 8, lines 5-8; Figures 5, 7.

[27] Healey; e.g., col. 6, lines 28-35; Figures 15-16.

[28] Specification; page 3, lines 1-3.

clamps 20 are moved together along the jig 36.[29] Each clip 32 is connected to a corresponding clamp 20, as claimed in intervening claim 2.[30] In contrast, the flanges 86 of Healey are part of a hinge that engages the hinge pin 90. A hinge is not a jig, and neither is a portion of a hinge. Any construction of the term "jig" that would include a hinge, as urged in the Final Action, sweeps too broadly and encompasses a number of structures and mechanisms that is far larger than set forth in the dictionary, thereby expanding the scope of the term far beyond its use by those skilled in the art.

With regard to dependent claims 7 and 8, claim 7 claims the "tool of claim 3, wherein one said clamp further comprises at least one alignment boss, and wherein the other said clamp comprises at least one boss receiver defined therein." The specification of the present application states that "[e]ach alignment boss 68 is a substantially cylindrical structure extending outward from the contact surface 37 of the first arm 22 of one clamp 20 toward the first arm 22 of the other clamp 20."[31] This usage of the term "alignment boss" corresponds with the dictionary definition of the word "boss," which is a protuberance on a part.[32] A boss receiver 70 associated with one clamp 20 is shaped to correspond to the shape of the outer surface of a corresponding alignment boss 68 associated with the other clamp 20.[33] The alignment boss 68 is received into the corresponding boss receiver 70, thereby causing the two clamps 20 to align more closely.[34]

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[29] Specification; *e.g.*, page 9, lines 5-7; page 11, lines 13-14; Figures 5, 7.

[30] Specification; e.g., page 8, line 5; Figures 5, 7.

[31] Specification; page 12, lines 19-21.

[32] MCGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS, FOURTH EDITION 244 (1989).

[33] Specification; page 12, lines 23-25.

[34] Specification; page 12, line 18 through page 13, line 4.

In contrast, the pin 90 of Healey is a hinge, not a boss.[35] As such, it is not a protuberance on a part, nor does it extend from a surface. Even if the hinge pin 90 of Healey is an alignment boss, which is not admitted, Healey nowhere discloses or suggests a boss receiver as claimed. Any construction of the term "boss" that would include a hinge, as urged in the Final Action, sweeps too broadly and encompasses a number of structures and mechanisms that is far larger than set forth in the dictionary, thereby expanding the scope of the term far beyond its use by those skilled in the art.

With regard to dependent claim 12, the rejection first speculates about a staple which is nowhere disclosed in Healey, then further speculates that a clamp (which is not identified with any reference numbers in Healey) is "capable" of deploying that undisclosed staple. Speculation piled on speculation cannot support a rejection based on anticipation. This rejection also fails as an implicit inherency rejection, because it is unsupported contrary to the requirements of the MPEP.

With regard to dependent claim 14, the elements 36, 38 of Healey are toothed latch elements that "consist of toothed members, the angle of the teeth being such as to provide a locking engagement therebetween."[36] The elements are brought into locked engagement to lock the device in place and prevent changing of position of the blood vessels relative to one another.[37] The toothed elements 36, 38 deploy nothing, much less one or more connectors, and receive nothing that is deployed. Thus, they are neither connector deployers, nor connector receivers, as incorrectly characterized in the Final Action.[38]

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[35] Healey; col. 6, lines 49-54; Figures 15-16.

[36] Healey; col. 4, lines 4-23; Figure 11.

[37] Healey; col. 5, lines 55-66.

[38] Final Action, page 4.

With regard to dependent claim 16, the Final Action states that "spring (92) is a kind of lever."[39] A spring is not a lever. A lever is "[a] rigid bar, pivoted about a fixed point (fulcrum), used to multiply force or motion."[40] Spring 92 is just a compression spring; it is not a rigid bar, nor does it pivot about a fixed point.[41]

Each and every element of claim 1 is not set forth in either Peters or Healey, and claim 1 is not anticipated by Peters or Healey. Therefore, the rejection of claim 1 under 35 U.S.C. §102 should be reversed by the Board.

B. The Cited Art Does Not Render Claim 1 Obvious

MPEP 706.02(j) states:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q. 1438 (Fed. Cir. 1991) (emphasis added).

Each of the arguments above with respect to Healey applies equally here. Healey neither teaches nor suggests all of the limitations of claim 1. Therefore, the rejection of claim 1 under 35 U.S.C. §103 should be reversed by the Board.

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[39] Final Action, page 4.

[40] MCGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS, FOURTH EDITION 1072 (1989).

[41] Healey; e.g., col. 6, lines 55-59; Figures 15-16.

C. Claim 13 Is Consistent with the Specification

Claim 13 depends indirectly from claim 1, and claims "[t]he tool of claim 12, further comprising a channel defined in at least one said clamp, wherein said actuator is movable through said channel relative to at least one said connector deployer." The specification was objected to on the grounds that the term "channel" was not set forth in the specification. Applicants point out that the term channel (80) is set forth in the specification at page 15, lines 18, 22, and 25, and at page 16, lines 1, 3, and 7, as well as in Figure 7. Thus, the specification provides proper written description and enablement for the claimed subject matter under MPEP §608.01(o), and terminology consistent with the specification is used in claim 13.

VII. CONCLUSION

For the above reasons, Applicants respectfully submit that the Final Action's rejection of pending claims 1-4, 6-8, 11, 12 and 14-16 was unfounded. Accordingly, Applicants request that the rejection of claims 1-4, 6-8, 11, 12 and 14-16 be reversed, and that those claims be allowed.

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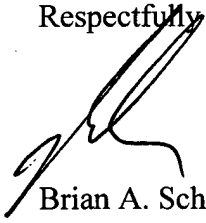
Respectfully submitted,



Brian A. Schar, Esq.
Attorney for Applicant
Reg. No. 45,076
(650) 331-7162

APPENDIX 1 -CLAIMS

1. A tool for performing end-to-end anastomosis between a first tissue structure and a second tissue structure each having at least two flaps at one end, comprising:

a first clip configured to hold at least one flap of the first tissue structure;

a second clip configured to hold at least one flap of the second tissue structure;

wherein said clips are movable from a first position spaced apart from one another to a second position closer to one another in which each flap held by said first clip abuts a corresponding flap held by said second clip; and

at least one connector deployer oriented to deploy at least one connector completely through at least one of two abutting flaps.

2. The tool of claim 1, further comprising a first clamp configured to hold the first tissue structure, and a second clamp configured to hold the second tissue structure; wherein said first clip is connected to said first clamp and said second clip is connected to said second clamp.

3. The tool of claim 2, further comprising a jig, wherein each said clamp is connected to said jig.

4. The tool of claim 3, wherein at least one said clamp is fixed to said jig.

5. The tool of claim 3, wherein said jig comprises at least one rail, and at least one said clamp is slidably connected to at least one said rail.

6. The tool of claim 3, further comprising a handle connected to each clamp, wherein said

handle is configured to urge at least one said clamp relative to said jig.

7. The tool of claim 3, wherein one said clamp further comprises at least one alignment boss, and wherein the other said clamp comprises at least one boss receiver defined therein.

8. The tool of claim 7, wherein each said alignment boss is substantially tubular.

11. The tool of claim 1, wherein at least one said connector is a staple.

12. The tool of claim 2, wherein at least one clamp comprises an actuator configured to actuate at least one said connector deployer.

13. The tool of claim 12, further comprising a channel defined in at least one said clamp, wherein said actuator is movable through said channel relative to at least one said connector deployer.

14. The tool of claim 2, wherein a first clamp comprises at least one connector deployer, and a second clamp comprises at least one connector receiver corresponding to said connector deployer on said first clamp.

15. The tool of claim 2, wherein each clamp comprises a first arm and a second arm moveable between an open position and a closed position.

16. The tool of claim 15, further comprising a clamping lever movably connected to at least

one said clamp, wherein motion of said clamping lever to a predetermined position locks said first arm and said second arm into said closed position.

17. The tool of claim 2, wherein each clamp comprises a passage defined therein; further comprising a finger moveable between said clamps through said passages.

18. The tool of claim 2, wherein each said clamp further comprises at least one tissue knife configured for cutting at least one flap.

APPENDIX 2 – EVIDENCE APPENDIX

Exhibit 1..... McGRAW HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS, FOURTH EDITION 244, 1072 (1989)

Exhibit 1

On the cover: Pattern produced from white light by a computer-generated diffraction plate containing 529 square apertures arranged in a 23 × 23 array. (R. B. Hoover, Marshall Space Flight Center)

On the title pages: Aerial photograph of the Sinai Peninsula made by Gemini spacecraft. (NASA)

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In addition, material has been drawn from the following references: R. E. Huschke, *Glossary of Meteorology*, American Meteorological Society, 1959; *U.S. Air Force Glossary of Standardized Terms*, AF Manual 11-1, vol. 1, 1972; *Communications-Electronics Terminology*, AF Manual 11-1, vol. 3, 1970; W. H. Allen, ed., *Dictionary of Technical Terms for Aerospace Use*, 1st ed., National Aeronautics and Space Administration, 1965; J. M. Gilliland, *Solar-Terrestrial Physics: A Glossary of Terms and Abbreviations*, Royal Aircraft Establishment Technical Report 67158, 1967; *Glossary of Air Traffic Control Terms*, Federal Aviation Agency; *A Glossary of Range Terminology, White Sands Missile Range, New Mexico*, National Bureau of Standards, AD 467-424; *A DOD Glossary of Mapping, Charting and Geodetic Terms*, 1st ed., Department of Defense, 1967; P. W. Thrush, comp. and ed., *A Dictionary of Mining, Mineral, and Related Terms*, Bureau of Mines, 1968; *Nuclear Terms: A Glossary*, 2d ed., Atomic Energy Commission; F. Casey, ed., *Compilation of Terms in Information Sciences Technology*, Federal Council for Science and Technology, 1970; *Glossary of Stinfo Terminology*, Office of Aerospace Research, U.S. Air Force, 1963; *Naval Dictionary of Electronic, Technical, and Imperative Terms*, Bureau of Naval Personnel, 1962; *ADP Glossary*, Department of the Navy, NAVSO P-3097.

McGRAW-HILL DICTIONARY OF SCIENTIFIC AND TECHNICAL TERMS, Fourth Edition

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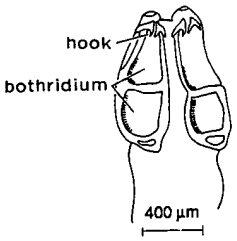
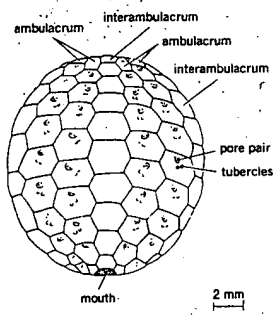


A drawing of the scolex of *Acanthobothrium* species showing the hooks on the bothridium.

BOTHRIOCIDAROIDA



A reconstruction of the test of *Bothriocidaris*.

unsuitable for gems because of its shape, size, or color and because of flaws or inclusions; used for abrasive and cutting purposes. { bȯrt }

bort bit *See* diamond bit. { 'bȯrt ˌpit }

Bosanquet's law [ELECTROMAG] The statement that, in analogy to Ohm's law for the resistance of an electric circuit, in a magnetic circuit the ratio of the magnetomotive force to the magnetic flux is a constant known as the reluctance. { 'bō·zənˌkets ˌlȯ }

Bosch fuel injection pump [MECH ENG] A pump in the fuel injection system of an internal combustion engine, whose pump plunger and barrel are a very close lapped fit to minimize leakage. { ˈbȯsh 'fyül inˈjek·shən ˌpəmp }

Bosch metering system [MECH ENG] A system having a helical groove in the plunger which covers or uncovers openings in the barrel of the pump; most usually applied in diesel engine fuel-injection systems. { ˈbȯsh 'mēd·ə·riŋ ˌsis·təm }

Bose distribution *See* Bose-Einstein distribution. { 'bōz disˌtrə'byü·shən }

Bose-Einstein condensation [CRYO] A phenomenon that occurs in the study of systems of bosons; there is a critical temperature below which the ground state is highly populated. Also known as condensation; Einstein condensation. { ˈbōz ˈīnˌstīn kän·denˈsā·shən }

Bose-Einstein distribution [STAT MECH] For an assembly of independent bosons, such as photons or helium atoms of mass number 4, a function that specifies the number of particles in each of the allowed energy states. Also known as Bose distribution. { ˈbōz ˈīnˌstīn dis·trə'byü·shən }

Bose-Einstein statistics [STAT MECH] The statistical mechanics of a system of indistinguishable particles for which there is no restriction on the number of particles that may exist in the same state simultaneously. Also known as Einstein-Bose statistics. { ˈbōz ˈīnˌstīn stə'tis·tiks }

Bose gas [STAT MECH] An assemblage of noninteracting or weakly interacting bosons. { 'bōz ˌgas }

bosh [MET] **1.** Tapering lower portion of a blast furnace, from the blast holes of the hearth up to the maximum internal diameter at the bottom of the stack. **2.** Quartz deposited on the furnace lining during the smelting of copper ore. { bäsh }

bosing [ARCHEO] A technique used to locate buried ditches or depressions in chalk subsoil; the soil surface is struck with a special board or tool, and the presence of a depression is then indicated by a characteristic sound. { 'bōz·iŋ }

boson [STAT MECH] A particle that obeys Bose-Einstein statistics; includes photons, pi mesons, and all nuclei having an even number of particles and all particles with integer spin. { 'bōˌsän }

bosporus [GEOGR] A strait connecting two seas or a lake and a sea. { 'bäs·pə·rəs }

bosque *See* temperate and cold scrub. { 'bäsk, 'bä·skā }

boss [DES ENG] Protuberance on a cast metal or plastic part to add strength, facilitate assembly, provide for fastenings, or so forth. [GEOL] A large, irregular mass of crystalline igneous rock that formed some distance below the surface but is now exposed by denudation. [NAV ARCH] *See* bossing. { bȯs }

bossing [NAV ARCH] **1.** A faired structural extension of the hull covering the propeller shaft where it emerges from the main hull and housing the main shaft bearing. **2.** The hub of a screw propeller. Also known as boss. { 'bȯs·iŋ }

bostonite [PETR] A rock with coarse trachytic texture formed almost wholly of albite and microcline and with accessory pyroxene. { 'bȯs·təˌnīt }

Boston ridge [BUILD] A method of applying shingles to the ridge of a house by which the shingles alternate in overlap from one side of the ridge to the other. { 'bȯs·tən ˌrij }

Bostrichidae [INV ZOO] The powder-post beetles, a family of coleopteran insects in the superfamily Bostrichoidea. { bä'strik·əˌdē }

Bostrichoidea [INV ZOO] A superfamily of beetles in the coleopteran suborder Polyphaga. { ˌbä·strə'kȯid·ē·ə }

botallackite [MINERAL] $Cu_2(OH)_3Cl·3H_2O$ A pale bluish-green to green, orthorhombic mineral consisting of a basic copper chloride; occurs as crusts of crystals. { bə'talˌəˌkīt }

botanical garden [BOT] An institution for the culture of plants collected chiefly for scientific and educational purposes. { bə'tan·ə·kəl 'gär·dən }

botany [BIOL] A branch of the biological sciences which embraces the study of plants and plant life. [TEXT] *See* merino. { 'bät·ən·ē }

bothridium [INV ZOO] A muscular holdfast organ, often with hooks, on the scolex of tetraphyllidean tapeworms. { bä'thrid·ē·əm }

Bothriocephaloidea [INV ZOO] The equivalent name for the Pseudophyllidea. { ˌbä·thrē·ō,sef·ə'lȯid·ē·ə }

Bothriocidaroida [PALEON] An order of extinct echinoderms in the subclass Perischoechinoidea in which the ambulacra consist of two columns of plates, the interambulacra of one column, and the madreporite is placed radially. { ˌbä·thrē·ōˌsik·ə'rȯid·ē·ə }

bothrium [INV ZOO] A suction groove on the scolex of pseudophyllidean tapeworms. { 'bäth·rē·əm }

botryogen [MINERAL] $MgFe(SO_4)_2(OH)·7H_2O$ An orange-red, monoclinic mineral consisting of a hydrated basic sulfate of magnesium and trivalent iron. { 'bä·trē·əˌjen }

botryoid [GEOL] **1.** A mineral formation shaped like a bunch of grapes. **2.** Specifically, such a formation of calcium carbonate occurring in a cave. Also known as clusterite. { 'bä·trēˌȯid }

botryoidal [SCI TECH] Of formations and structures, shaped like a bunch of grapes. { 'bä·trēˌȯid·əl }

botryomycosis [VET MED] A chronic infectious bacterial disease of horses caused by *Staphylococcus aureus* and characterized by localized fibromatous tumors. { ˌbä·trē,mī'kō·səs }

Botrytis disease [PL PATH] Any of various fungus diseases of plants caused by fungi of the genus *Botrytis;* characterized by soft rotting. { bō'trīd·əs diˌzēz }

bottle [ENG] A container made from pipe or plate with drawn, forged, or spun end closures, and used for storing or transporting gas. { 'bäd·əl }

bottle centrifuge [ENG] A centrifuge in which the mixture to be separated is poured into small bottles or test tubes; they are then placed in a rotor assembly which is spun rapidly. { 'bäd·əl 'sen·trəˌfyüj }

bottled gas [MATER] Butane, propane, or butane-propane mixtures liquefied and bottled under pressure for use as a domestic cooking or heating fuel. Also known as bugas. { ˌbäd·əld 'gas }

bottle graft [BOT] A plant graft in which the scion is a detached branch and is protected from wilting by keeping the base of the branch in a bottle of water until union with the stock. { 'bäd·əl ˌgraft }

bottleneck [PETRO ENG] A section of reduced diameter in a drill pipe that is caused by excessive longitudinal strain or a combination of such strain and irregular swaying of the mechanism. { 'bäd·əlˌnek }

bottleneck analysis [COMPUT SCI] A detailed study of the manner in which elements of a computer system are related to find out where bottlenecks arise, so that the system's performance can be improved. { 'bäd·əl,nek əˌnal·ə·səs }

bottleneck assignment problem [IND ENG] A linear programming problem in which it is required to assign machines to jobs (or vice versa) so that the efficiency of the least efficient operation is maximized. { 'bäd·əl,nek əˈsīn·mənt ˌpräb·ləm }

bottle test [PETRO ENG] An analytical procedure in which a chemical is added to samples of a water-oil emulsion to determine the quantity of chemical needed to separate the emulsion into oil and water fractions. { 'bäd·əl ˌtest }

bottle thermometer [ENG] A thermoelectric thermometer used for measuring air temperature; the name is derived from the fact that the reference thermocouple is placed in an insulated bottle. { 'bäd·əl thərˈmäm·əd·ər }

bottom [COMPUT SCI] The termination of a file. [GEOL] **1.** The bed of a body of running or still water. **2.** *See* root. [PARTIC PHYS] The new quantum number associated with the bottom quark. Also known as beauty. { 'bäd·əm }

bottom blow [ENG] A type of plastics blow molding machine in which air is injected into the parison from the bottom of the mold. { 'bäd·əm ˌblō }

bottom break [BOT] A branch that arises from the base of a plant stem. [MIN ENG] The break or crack that separates a block of stone from a quarry floor. { 'bäd·əm ˌbrāk }

bottom chord [CIV ENG] Any of the bottom series of truss members parallel to the roadway of a bridge. { 'bäd·əm ˌkȯrd }

bottom dead center [MECH ENG] The position of the crank of a vertical reciprocating engine, compressor, or pump when

level scheme *See* energy-level diagram. { 'lev·əl ˌskēm }

level set [COMPUT SCI] A revision of a software package in which most or all of the executable programs are replaced with improved versions. { 'lev·əl ˌset }

level shifting [ELECTR] Changing the logic level at the interface between two different semiconductor logic systems. { 'lev·əl ˌshif·tiŋ }

level surface [ENG] A surface which is perpendicular to the plumb line at every point. [GEOPHYS] *See* geopotential surface. { 'lev·əl 'sər·fəs }

level valve [MECH ENG] A valve operated by a lever which travels through a maximum arc of 180°. { 'lev·əl ˌvalv }

level width [QUANT MECH] A measure of the spread in energy of an unstable state, equal to the difference between the energies at which intensity of emission or absorption of photons or particles, or the cross section for a reaction, is one-half its maximum value. { 'lev·əl 'width }

Levenstein process [CHEM ENG] A process for the manufacture of mustard gas from ethene, $CH_2{=}CH_2$, and sulfur chloride, S_2Cl_2. { 'le·vən,stīn ˌprä·səs }

lever [ENG] A rigid bar, pivoted about a fixed point (fulcrum), used to multiply force or motion; used for raising, prying, or dislodging an object. { 'lev·ər, lē·vər }

leverage [MECH] The multiplication of force or motion achieved by a lever. { 'lev·rij }

lever escapement [HOROL] A clock movement in which the balance wheel is connected to the escapement by a lever attached to a roller; the wheel swings through a much larger angle than does a pendulum. { 'lev·ər is,kāp·mənt }

leveret [VERT ZOO] A young hare. { 'lev·rət }

Leverett function [FL MECH] A dimensionless number used in studying two-phase flow in porous mediums, written as $(\xi/e)^{1/2}(p/\sigma)$, where ξ is the permeability of a medium (as defined by Darcy's law), e is the medium's porosity, σ is the surface tension between two liquids flowing through it, and p is the capillary pressure. { 'lev·rət ˌfəŋk·shən }

lever shears [DES ENG] A shears in which the input force at the handles is related to the output force at the cutting edges by the principle of the lever. Also known as alligator shears; crocodile shears. { 'lev·ər ˌshirz }

lever switch [ELEC] A switch having a lever-shaped operating handle. { 'lev·ər ˌswich }

Levi-Civita symbol [MATH] A symbol $\epsilon_{i,j,\ldots,s}$ where $i, j, \ldots, s$ are n indices, each running from 1 to n; the symbol equals zero if any two indices are identical, and 1 or -1 otherwise, depending on whether $i, j, \ldots, s$ form an even or an odd permutation of $1, 2, \ldots, n$. { 'lā·vē chē·vē'tä ˌsim·bəl }

levigate [BOT] *See* glabrous. [CHEM] To separate a finely divided powder from a coarser material by suspending in a liquid in which both substances are insoluble. Also known as elutriation. **2.** To grind a moist solid to a fine powder. { 'lev·əˌgāt }

levigated abrasive [MATER] A fine abrasive powder for final burnishing of metals or for metallographic polishing; the powder is usually processed to make it chemically neutral. { 'lev·əˌgād·əd ə'brā·siv }

levisticum oil *See* lovage oil. { lə'vis·tə·kəm ˌöil }

levitated vehicle [MECH ENG] A train or other vehicle which travels at high speed at some distance above an electrically conducting track by means of levitation. { 'lev·əˌtād·əd 'vē·ə·kəl }

levitation [MIN ENG] In froth flotation, raising of particles in a froth to the surface of the pulp, to facilitate separation of selected minerals in the froth. [PHYS] The use of a force that does not involve physical contact to balance gravity, such as that associated with an electric or magnetic field, or electromagnetic or acoustic radiation. { ˌlev·ə'tā·shən }

levitation heating [MET] Providing heat through high-frequency magnetic fields; employed in levitation melting. { ˌlev·ə'tā·shən ˌhēd·iŋ }

levitation melting [MET] Melting metal out of contact with a supporting material by using the induced current provided by a high-frequency surrounding magnetic field to suspend the melt. { ˌlev·ə'tā·shən ˌmel·tiŋ }

levocardia [MED] Location of the heart on the left side associated with visceral situs inversus and congenital cardiac disease. { ˌlēv·əˌkär·dē·ə }

levodopa [PHARM] $C_9H_{11}NO_4$ Crystals or crystalline powder, soluble in dilute hydrochloric acid and in formic acid; used as an anticholinergic drug and in the treatment of Parkinson's disease. L-dopa. { ˌlev·əˌdō·pə }

levo form [PHYS CHEM] An optical isomer which induces levorotation in a beam of plane polarized light. { 'lē·vō ˌförm }

levophobia [PSYCH] An abnormal fear of objects to the left of the body. { ˌlēv·ə'fō·bē·ə }

levorotation [OPTICS] Rotation of the plane of polarization of plane polarized light in a counterclockwise direction, as seen by an observer facing in the direction of light propagation. Also known as levulorotation. { ˌlē·və·rō'tā·shən }

levotropic cleavage [EMBRYO] Spiral cleavage with the cells displaced counterclockwise. { ˌlē·vəˌträp·ik 'klē·vij }

levulinic acid [ORG CHEM] $CH_3COCH_2CH_2COOH$ Crystalline compound forming plates or leaflets that melt at 37°C; freely soluble in alcohol, ether, and chloroform; used in the manufacture of pharmaceuticals, plastics, rubber, and synthetic fibers. { ˌlev·yəˌlin·ik 'as·əd }

levulorotation *See* levorotation. { ˌlē·vyə·lō·rō'tā·shən }

levulose [BIOCHEM] Levorotatory D-fructose. { 'lev·yəˌlōs }

levulose tolerance test [PATH] A liver function test based on the observation that blood sugar increases in cases of hepatic disease following oral administration of levulose. { 'lev·yəˌlōs 'täl·ə·rəns ˌtest }

levyine *See* levynite. { lā'vē,īn }

levyite *See* levynite. { lā'vē,īt }

levyne *See* levynite. { lā'vēn }

levynite [MINERAL] $NaCa_3Al_7Si_{11}O_{36}\cdot 15H_2O$ A white or light-colored mineral of the zeolite group, composed of hydrous silicate of aluminum, sodium, and calcium, and occurring in rhombohedral crystals. Also known as levyine; levyite; levyne. { lā'vē,nīt }

lewis [DES ENG] A device for hoisting heavy stones; employs a dovetailed tenon that fits into a mortise in the stone. { 'lü·əs }

Lewis acid [CHEM] A substance that can accept an electron pair from a base; thus, $AlCl_3$, BF_3, and SO_3 are acids. { 'lü·əs ˌas·əd }

Lewis base [CHEM] A substance that can donate an electron pair; examples are the hydroxide ion, OH^-, and ammonia, NH_3. { 'lü·əs ˌbās }

Lewis blood group system [IMMUNOL] An antigen, designated by Le^a, first recognized in a Mrs. Lewis, occurring in about 22% of the population, detected by anti-Le^a antibodies primarily composed of soluble antigens of serum and body fluids like saliva, with secondary absorption by erythrocytes. { 'lü·əs 'bləd ˌgrüp ˌsis·təm }

lewis bolt [DES ENG] A bolt with an enlarged, tapered head that is inserted into masonry or stone and fixed with lead; used as a foundation bolt. { 'lü·əs ˌbōlt }

Lewis gun [ORD] A gas-operated machine gun with a horizontal drum magazine, manufactured in several modifications; now obsolete. { 'lü·əs ˌgən }

lewis hole [MIN ENG] A series of two or more holes drilled as closely together as possible, but then connected by knocking out the thin partition between them, thus forming one wide hole having its greatest diameter in a plane with the desired rift. { 'lü·əs ˌhōl }

lewisite [MINERAL] $(Ca,Fe,Na)_2$ A titanian romeite mineral. [ORG CHEM] $C_2H_2AsCl_3$ An oily liquid, colorless to brown or violet; forms a toxic gas, used in World War I. { 'lü·əˌsīt }

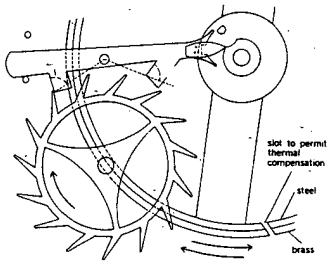
Lewis-Matheson method [CHEM ENG] Trial-and-error calculation method for the design of multicomponent distillation columns, or for the determination of the separating ability of an existing column. { 'lü·əs 'math·ə·sən ˌmeth·əd }

Lewis number [PHYS] **1.** A dimensionless number used in studies of combined heat and mass transfer, equal to the thermal diffusivity divided by the diffusion coefficient. Symbolized *Le*; N_{Le}. **2.** Sometimes, the reciprocal of this quantity. { 'lü·əs ˌnəm·bər }

lewis pin [MIN ENG] A pin used for attachment to a key block; it is placed in a shallow drill hole with a wedge at either side. { 'lü·əs ˌpin }

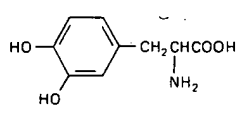
lewistonite [MINERAL] $(Ca,K,Na)_5(PO_4)_3(OH)$ White mineral composed of basic calcium potassium sodium phosphate. { 'lü·əs·təˌnīt }

Lexell's Comet [ASTRON] A small comet that approached



LEVER ESCAPEMENT

The lever escapement, used in good spring clocks and watches, is detached from the balance wheel during most of a cycle, thus promoting accurate timekeeping.



LEVODOPA

Structural formula.